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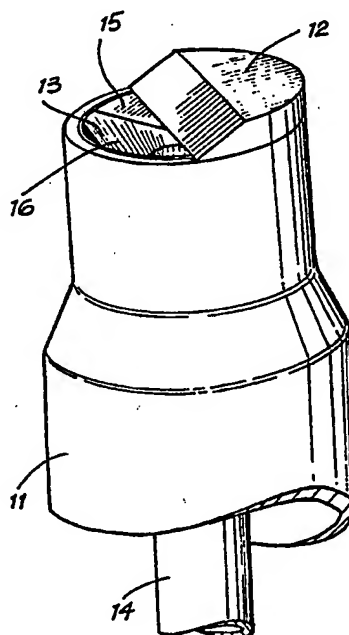
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(54) Title: CO-AXIAL TUBE SURGICAL INFUSION/SUCTION CUTTER TIP

(57) Abstract

Surgical instrument for accurately cutting and removing fibrous tissue comprising a first tube (11) having at one end an end wall (12) disposed in a plane substantially normal to the longitudinal axis of the first tube (11), which end wall contains an aperture (13); a second tube (14) coaxial with the first tube (11) and having at one end an end wall (15) disposed in a plane substantially normal to the longitudinal axis of the second tube (14) which end wall (15) contains an aperture (16) and lies in closed juxtaposition with the end wall (12) of the first tube (11); means (17) to enable the tubes (11 and 14) to be rotated relative to one another such that the apertures (13 and 16) are moved into and out of register with one another; duct means (19 and 20) to direct a stream of an irrigating liquid to the said one end of the tubes (11 and 14); and duct means (21, 37, 36 and 35) to connect the interior of the second tube (14) to a source of suction.



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CO-AXIAL TUBE SURGICAL INFUSION/SUCTION CUTTER TIP

TECHNICAL FIELD

The present invention relates to a surgical instrument and more particularly to a surgical instrument useful for cutting fibrous tissue during surgical procedures on humans and animals.

BACKGROUND ART

10 In certain surgical operations it is necessary to cut out and remove fibrous tissue with a high degree of accuracy and from locations which are frequently inaccessible. An example of such an operation is the removal of brain tumors where the tumor needs to be cut out and removed with the minimum possible damage to the surrounding tissue.

There is available on the market a surgical device intended for use in such situations which comprises a first outer tube which is closed at its free end and has an aperture in its side wall a short distance in from the free
20 end of the tube. A second tube is disposed within the first tube and arranged to reciprocate longitudinally along the first tube past the aperture. In this arrangement when the aperture is pressed against an area of tissue some of the tissue will bulge into the interior of the first tube and be severed by the reciprocating second tube. Substantial disadvantages with this arrangement are that, firstly, the tip of the instrument must be pushed past the tissue to be removed to bring the aperture into juxtaposition with the tissue to be removed and, secondly, it is difficult to
30 accurately direct the cutting operation when moving the instrument laterally of its longitudinal axis as is necessary to continue to offer up the aperture to the tissue to be removed.



DISCLOSURE OF THE INVENTION

The present invention consists in a surgical instrument comprising a first tube having at one end an end wall disposed in a plane substantially normal to the longitudinal axis of the first tube which end wall contains an aperture; a second tube disposed within the first tube and having at one end an end wall disposed in a plane substantially normal to the longitudinal axis of the second tube which end wall lies in close juxtaposition with the end wall of the first
10 tube and contains an aperture; means to enable the tubes to be rotated relative to one another such that the apertures in the end walls of the tubes are moved into register and substantially completely out of register with one another; duct means to direct a stream of a liquid to the said one ends of the tubes; and duct means to connect the interior of the second tube to a source of suction.

The first and second tubes are preferably each cylindrical and disposed coaxially. The aperture in each tube may be solely in the end wall of the tube or it may be
20 placed partially in the end wall and partially in the side wall of the tube. It is, however, essential to have at least part of the aperture in the end wall to allow the very tip of the instrument to have an active cutting function.

In order to obtain a good cutting action it is preferred that the edge of each end wall where it abuts its associated aperture be sharpened to form a cutting blade such that tissue entering the apertures when they are in register will be clearly severed from the adjoining tissue. It is also preferred that the end walls of the two tubes be resiliently
30 urged into juxtaposition by spring means or the like as this also assists in providing a good cutting action.

Any suitable motor may be used to cause the relative rotational movement between the tubes. The motor may either form part of the device itself or it may form a separate unit which drives the surgical instrument through a flexible drive



or the like. It is preferred that the inner tube be rotated and the outer tube remain stationary however this is not essential to the present invention. In other embodiments of the invention both tubes may be rotated or only the outer tube may rotate. It is also possible to have the direction of relative rotational movement change periodically should this be necessary.

The duct means to direct a stream of liquid to the said one ends of the tubes preferably comprises an annular space
10 between the two tubes. It is however important that the liquid stream, which is preferably an isotonic saline solution, is directed so that the area of tissue to be removed is irrigated before the liquid is sucked up by the suction source acting through the interior of the second tube.

The duct means connecting the suction source to the interior of the inner tube preferably includes a valve to admit air to the duct means, downstream of the inner tube. This valve means can be used to control the effective amount of suction at the tip of the surgical instrument. As the
20 suction pressure draws tissue into the aperture the extent of the suction pressure substantially determines the rate at which tissue is removed by the surgical instrument. The valve means thus enables the effective cutting rate of the instrument to be controlled while it is being used. The valve means preferably comprises a passage opening into a side wall of the instrument such that a user's thumb may be slid over the opening of the passageway to limit the amount of air flowing into the suction line and thereby to control the suction pressure at the tip of the instrument.

30

BRIEF DESCRIPTION OF THE DRAWINGS

Hereinafter given by way of example only is a preferred embodiment of this invention described with reference to the accompanying drawings in which :



Fig. 1 is a longitudinal sectional view through a surgical instrument according to this invention;

Fig. 2 is an enlarged perspective view of the tip of the surgical instrument of Fig. 1;

Fig. 3 is an enlarged longitudinal sectional view of the tip of the surgical instrument of Fig. 1 with the apertures in the end walls of the inner and outer tubes in register; and

Fig. 4 is an enlarged longitudinal sectional view of the tip of the surgical instrument of Fig. 1 with the apertures in the end walls of the inner and outer walls out of register.

THE BEST MODE OF CARRYING OUT THE INVENTION

The surgical instrument 10 includes a first, outer tube 11 having at its free end an end wall 12 in which is provided an aperture 13 and a second, inner, tube 14 disposed within the outer tube 11 and rotatable relative thereto. An end wall 15 on the second tube 14 is provided with an aperture 16 which moves into and out of register with the aperture 13 in the outer tube 11 as the inner tube 14 is rotated. The inner tube 14 is mounted on a drive spindle 17 containing seals 18 to separate the spaces containing pressurised liquid from those forming the suction pathway, and is rotated in housing 26 about its longitudinal axis by motor means (not shown). An inlet port 19 is provided for introducing an irrigating liquid into the annular space 20 between the outer tube 11 and the inner tube 14 while an outlet port 21 is provided for the connection of the interior of the inner tube 14 with a suction source (not shown).

The outer tube 11 extends into a bore 27 in a cylindrical bush 22 and is held in angular register with the housing 26 by a radially extending pin 23 which engages in a slot in the end of the housing 26. The bush 22 is in turn positioned in a bore 25 of a housing 26, a radially directed



flange 27 on the bush 22 bears against the free end of the housing 26 surrounding the end of the bore 25 and the bush 22 is held in place by a threaded collar 24 which engages with a threaded outer surface of the housing 26. An "o" ring 28 is positioned in a circumferential groove 29 in the bush 22 to provide a liquid-tight seal between the bush 22 and the housing 26.

The inner tube 14 is at its cutting end provided with a collar 30 of increased diameter which just fits into a zone 10 31 of the outer tube 11 which is of reduced diameter. Adjacent its non-cutting end the inner tube 14 extends through, and is connected to a ferrule 32. At its end distal to the tip of the surgical instrument 10 the ferrule 32 is provided with a pair of diametrically opposed radially directed lugs 33 which extend into slots in one end of the drive spindle 17. A spring 34 extends between one end of the drive spindle 17 and a flange 35 at the end of the ferrule distal to the spindle 17. The spring 34 serves to push the ferrule 32, and the inner tube 14 attached thereto in a 20 direction which forces the end wall 15 of the inner tube 14 into close juxtaposition with the end wall of the outer tube 11.

The end of the inner tube 14 adjacent the ferrule 32 extends into a bore 35 in the spindle 17 and is surrounded by an "o" ring to form a seal between the spindle 17 and the inner tube 14. The bore 35 communicates with a radial bore 36 which in turn communicates with an annular recess 37 which surrounds the spindle. The suction outlet port 21 in the housing 26 communicates with the annular recess 37.

30 The housing is formed on its side opposite the outlet port 21 with a radially extending bore 38 which opens into the annular recess 37 at one end and opens into an elongate slot 39 in the side wall of the housing 26 at the other. The slot 39 is so placed that a surgeon using the instrument can slide his thumb along the slot to control the amount of air



flowing into the annular recess 37 through the slot 39 which in turn controls the amount of suction pressure which will be present in the inner tube 14.

The end walls 12 and 15 are provided along their edges bounding respectively the apertures 13 and 16 with a sharpened edge such that when the inner tube is rotated there will be a scissor like cutting action between those edges as the apertures are moving out of register.

In use the drive spindle 17 is connected to a motor of
10 some suitable type such as an electric motor or a fluid turbine of the type used in dental drills, the inlet port 19 is connected to a source of isotonic saline solution or some other suitable irrigating liquid, and the outlet port 21 is connected to a source of suction pressure. Upon actuating the motor the inner tube will be rotated and as this happens the irrigating liquid will flow down the annular space 20 and between the collar 30 and the necked-down portion 30 of the outer tube 11. When the tip of the instrument 10 is placed in juxtaposition with tissue to be cut away and the slot 39
20 substantially closed the tissue is sucked into the inner tube 14 when the apertures 13 and 16 are in juxtaposition and the tissue so sucked into the tube is then cut off and drawn up the tube 14 as the tube 14 rotates.



CLAIMS

1. A surgical instrument comprising a first tube having at one end an end wall disposed in a plane substantially normal to the longitudinal axis of the first tube which end wall contains an aperture; a second tube disposed within the first tube and having at one end an end wall disposed in a plane substantially normal to the longitudinal axis of the second tube which end wall lies in close juxtaposition with the end wall of the first tube and contains an aperture; means to enable the tubes to be rotated relative to one another such that the apertures in the end walls of the tubes are moved into register and substantially completely out of register with one another; duct means to direct a stream of a liquid to the said one ends of the tubes; and duct means to connect the interior of the second tube to a source of suction.
2. A surgical instrument as claimed in Claim 1 in which the first and second tubes are cylindrical and are disposed coaxially.
3. A surgical instrument as claimed in Claim 1 in which the aperture in each of the tubes is wholly within the plane of the end wall of that tube.
4. A surgical instrument as claimed in Claim 1 in which the edges of each end wall bounding its associated aperture are sharpened to form a cutting edge.
5. A surgical instrument as claimed in Claim 1 in which means are provided to resiliently urge the end walls into close juxtaposition.
6. A surgical instrument as claimed in Claim 1 in which the relative rotation of the tubes is achieved by holding the outer tube stationary and rotating the inner tube.
7. A surgical instrument in which the duct means to direct a liquid stream to the said one end of the tubes includes the annular space between the two tubes.
8. A surgical instrument as claimed in claim 1 in which the duct means to connect the interior of the second tube to a



source of suction includes valve means to admit air to the said duct means.

9. A surgical instrument as claimed in claim 8 in which the valve means comprises an aperture in a side wall of the surgical instrument which opens into the said duct means the size of which aperture may be manually adjusted.



AMENDED CLAIMS

(received by the International Bureau on 16 March 1981 (16.03.1981))

CLAIMS

1. (Amended) A surgical instrument comprising a first tube having at one end an end wall disposed in a plane substantially normal to the longitudinal axis of the first tube which end wall contains an aperture; a second tube disposed substantially coaxially within the first tube and having at one end an end wall disposed in a plane substantially normal to the longitudinal axis of the second tube which end wall is resiliently urged into close juxtaposition with the end wall of the first tube and contains an aperture; means to enable the tubes to be rotated relative to one another about their common axis, the apertures in the end walls of the tubes each lying wholly within the plane of its associated end wall and the apertures being so placed in the end walls that they are moved into register and substantially completely out of register with one another as the tubes are rotated relative to one another; duct means to direct a stream of a liquid to the said one ends of the tubes; and duct means to connect the interior of the second tube to a source of suction, an edge portion of each aperture being sharpened such that the edge portions together form cooperating shearing blades as the apertures are moved out of register.

2. (Cancelled).

3. (Cancelled).

4. (Cancelled).

5. (Cancelled).

6. A surgical instrument as claimed in Claim 1 in which the relative rotation of the tubes is achieved by holding the outer tube stationary and rotating the inner tube.

7. A surgical instrument in which the duct means to direct a liquid stream to the said one end of the tubes includes the annular space between the two tubes.

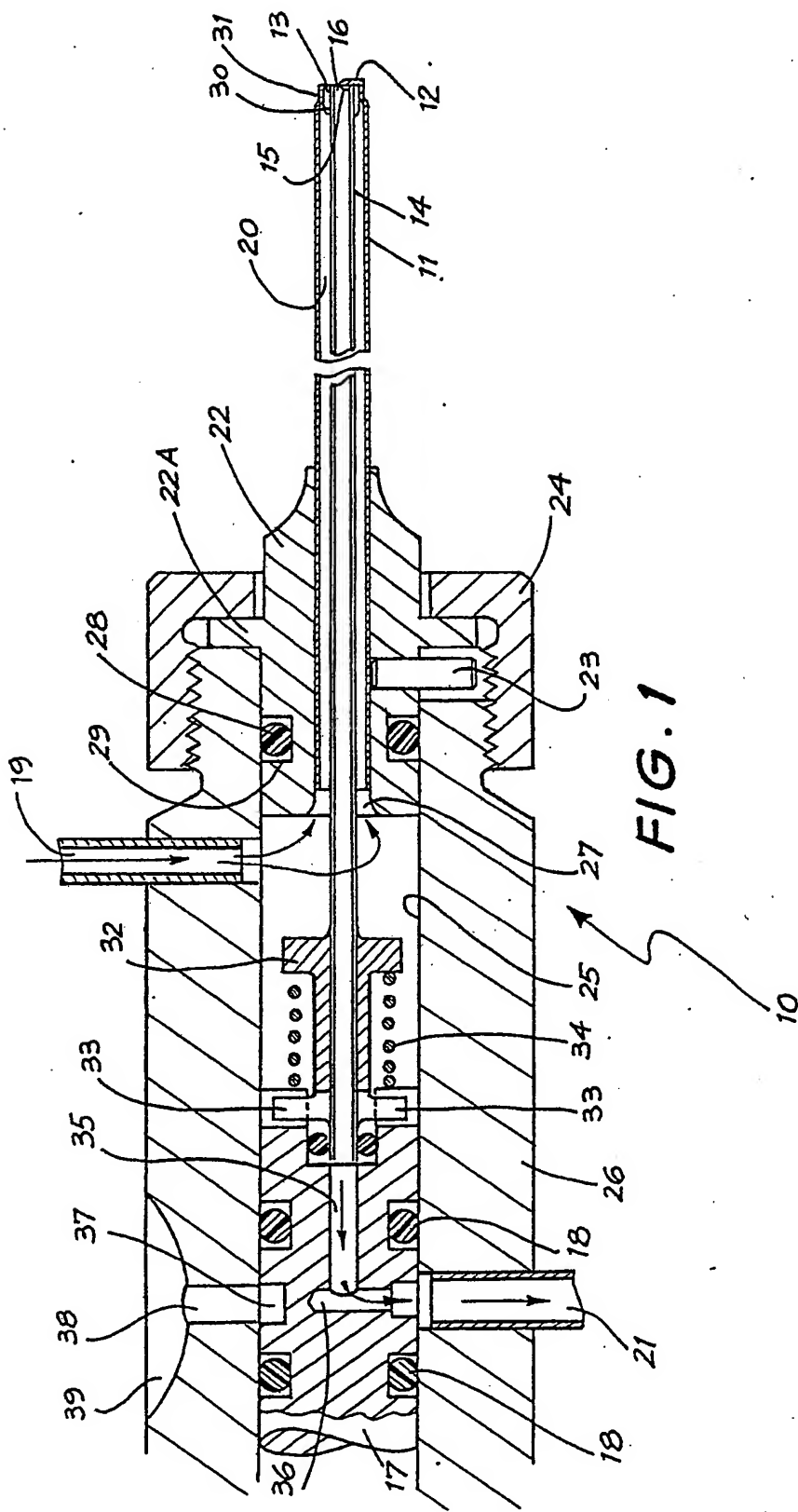
8. (Amended) A surgical instrument as claimed in claim 1 in which the duct means to connect the interior of the second



tube to a source of suction includes a by-pass path to admit air to the said duct means.

9. (Amended) A surgical instrument as claimed in claim 8 in which the by-pass path comprises an aperture through a side wall of the surgical instrument which opens into the said duct means, the effective cross sectional area of which aperture and by-pass path may be manually adjusted.





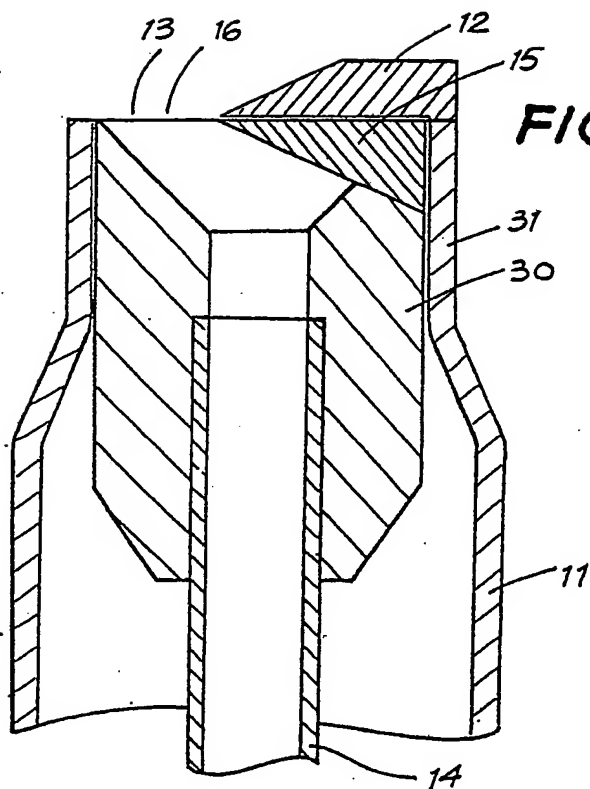


FIG. 3

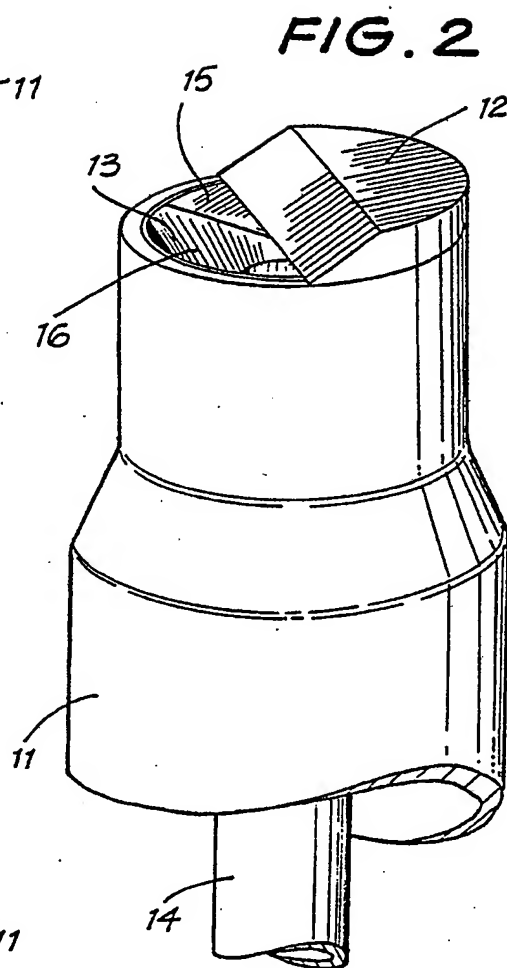


FIG. 2

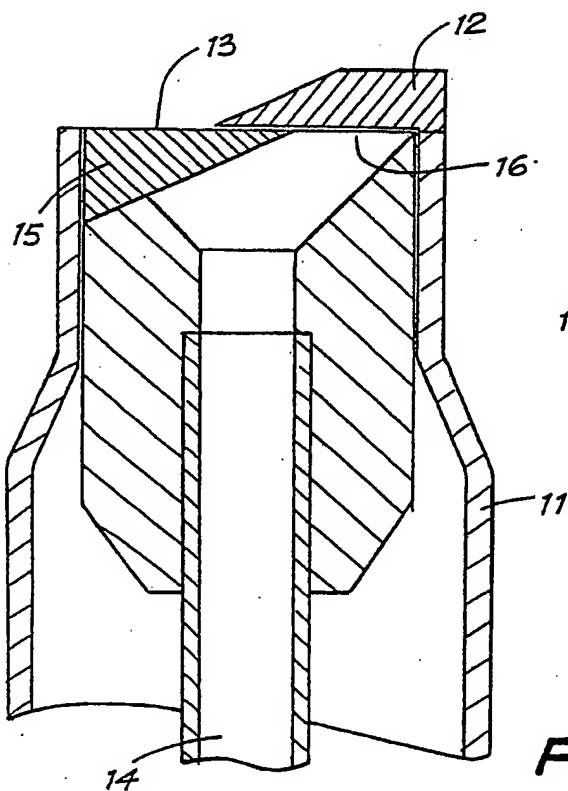


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 80/00094

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| I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ³ | | |
| According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. ³ A61B 17/32, A61M 1/00, 7/00 | | |
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| Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵ | | |
| AU: IPC as above, Australian Classification 87.4 | | |
| III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ | | |
| Category ⁶ | Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷ | Relevant to Claim No. ¹⁸ |
| X | AU, B, 17484/70 published 1972 January 20 (& CH 10470/70 (518714) & DE 2035181 & FR 2054994 & GB 1286339 & US Appln.No. 841741) BENDER, PAGE & WOLD | |
| X | FR, B, 2211207 published 1974 June 19, KRASNOV, BOCHOROV, GOLYAMINA and KOVALKOV | |
| X | FR, B, 2226974 published 1974 November 22 DOUVAS & DINKELKAMP | |
| X | US, A, 3526219 published 1970 September 1 LEWIS BALANUTH | |
| X | US, A, 3589363 published 1971 June 29 ANTON BAIKO | |
| X | US, A, 3670412 published 1972 June 20 FRANK CUNNINGHAM | |
| X | US, A, 3732858 published 1973 May 15 ANTON BANKO | |
| X | US, A, 3734099 published 1973 May 22 BENDER, PAGE & WOLD | |
| X | US, A, 3884238 published 1975 May 20 O'MALLEY & HEINTZ | |
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| ¹⁵ Special categories of cited documents: ¹⁵ | | |
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| IV. CERTIFICATION | | |
| Date of the Actual Completion of the International Search ¹⁹ | Date of Mailing of this International Search Report ²⁰ | |
| 06 January 1981 (06/01/81) | 16 January 1981 (16.01.81) | |
| International Searching Authority ¹ | Signature of Authorized Officer ²⁰ | |
| Australian Patent Office | J.I. Welsh | |

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

- | | |
|---|--|
| X | DE, A, 2064783 published 1971 August 12 DINKELKAMP & DOUVAS |
| X | SU, A, 439281 published 1975 January 20 KHATMINSKII |
| X | GB, A, 2007098 published 1979 May 16 DYONICS INC. |
| X | GB, A, 2018601 published 1979 October 24 MICROSURGICAL ADMINISTRATIVE SERVICES LTD. |

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers _____, because they relate to subject matter ¹² not required to be searched by this Authority, namely:
2. ☐ Claim numbers _____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.